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FERRUGINOUS PYGMY-OWLS: A NEW HOST FOR *PROTOCALLIPHORA SIALIA* AND *HESPEROCIMEX SONORENSIS* IN ARIZONA

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ABSTRACT.—While banding Cactus Ferruginous Pygmy-Owls (*Glaucidium brasilianum cactorum*) in Arizona, we removed three *Protocalliphora sialia* (Diptera: Calliphoridae) from the wing margin of one nestling. Subsequent inspection of nest material revealed an additional 119 *Hesperocimex sonorensis* (Hemiptera: Cimicidae), another hematophagous parasite. All nestlings (n = 3) fledged successfully, but on day 8 postfledging, two fledglings were found dead and one was missing. Although unsubstantiated, the subclinical effect (e.g., anemia) of these hematophagous parasites may have contributed to the fledglings' demise. This is the first published record of *P. sialia* parasitizing Ferruginous Pygmy-Owls and the first documented infestation of *H. sonorensis* for nesting Ferruginous Pygmy-Owls. *Received 2 August 2004, accepted 23 February 2005.*

Cactus Ferruginous Pygmy-Owls (*Glaucidium brasilianum cactorum*, hereafter pygmy-owl) are secondary obligate cavity nesters that require mature trees, including large columnar cacti, for nesting (Proudfoot and Johnson 2000). In March 1997, the U.S. Fish and Wildlife Service listed the pygmy-owl as endangered in Arizona (U.S. Fish and Wildlife Service 1997). In 1999, only 41 adult pygmy-owls were known to exist in Arizona. In 2000 and 2001, population sizes in Arizona were 34 and 36 adults, respectively (U.S. Fish and Wildlife Service 2003).

On 2 June 2002, during a cooperative study of nesting ecology and phylogeography of pygmy-owls in Arizona, we removed three dipteran larvae from the right wing of one pygmy-owl nestling. Larvae were incidentally discovered and then removed during routine banding of nestlings. The larvae, later identified by T. L. Whitworth as *P. sialia* (Diptera: Calliphoridae), were on the wing margin between secondary remiges number 5 and 6, 6 and 7, and 10 and 11. We preserved larvae in 95% ethanol and vouchered samples as study specimens at the Texas Cooperative Wildlife Collection at Texas A&M University in College Station. Subsequent examination of the infested nestling's siblings revealed no additional ectoparasites. To the best of our knowledge, this is the first record of *P. sialia* parasitizing pygmy-owls.

The nest cavity was 3.5 m above ground level in a saguaro cactus (*Carnegiea gigantea*) in the Altar Valley southwest of Tucson, Arizona. The entrance diameter (7.5 × 9.0 cm) was large enough to remove nestlings and nest material by hand. After the nestlings fledged, we removed and examined nest material for additional *P. sialia*; none were found. However, we did collect 119 *Hesperocimex sonorensis* (Hemiptera: Cimicidae), another hematophagous parasite. To the best of our knowledge, this is the first published record of *H. sonorensis* infesting a pygmy-owl nest cavity. Due to funding and time limitations, nest material was not examined from any other pygmy-owl nest cavities.

The Calliphoridae mostly comprise necrophagous fly species that, in the larval stage, consume carrion or decaying flesh in wounds, and are generally known as blow flies (Mullen and Durden 2002). Larval *Protocalliphora*, however, are hematophagous parasites that commonly feed on nestlings of nidicolous birds (Hill and Work 1947, Bohm 1978, Boland et al. 1989, Merino and Potti 1998). Few studies have shown a direct link between *Protocalliphora* infestations and nestling mortality or reductions in nest productivity (Gold and Dahlsten 1983, Roby et al. 1992). However, recent studies have found evidence of indirect links between hematophagous parasites and nestling-to-fledgling survival. For example, in House Wrens (*Troglodytes aedon*)

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a >25% loss in hemoglobin levels was attributed to blood feeding by *P. parorum* and *Dermanyssus hirudinis* (a mite; Acari: Mesostigmata: Dermanyssidae). A hemoglobin deficiency of this magnitude may significantly reduce the transport of oxygen to tissues. If fledglings retain low hemoglobin and oxygen levels, their anemic state may have a negative effect on the birds' survivorship by reducing the ability to sustain flight and escape predators (O'Brien et al. 2001). In Blue Tits (*Parus caeruleus*), there was a strong negative correlation between the heritability of chick body size and *Protocalliphora* infestation, as young of infested nests produced offspring with a shorter than average tarsus (Charmantier et al. 2004).

The Cimicidae includes about thirty species of blood-feeding ectoparasites world wide. In birds, infestation of *Oeciacus vicarius* was attributed to the abandonment of nest houses used by adult Purple Martins (*Progne subis*), and to the death of 10 nestlings that fledged prematurely (Loye and Ragan 1991). In Nebraska, high infestation of *O. vicarius* was credited with reduced body condition and seasonal decline in reproductive success of Cliff Swallows (*Petrochelidon pyrrhonota*; Brown and Brown 1986, 1999). Continued study showed that parasitized nestlings had increased asymmetry in wing and tail feathers, possibly due to nutritional stress resulting from blood loss. Feather asymmetry may impair flight performance and reduce foraging efficiency, a possible fitness cost to Cliff Swallows (Brown and Brown 2002). In New Mexico, infestation of *Haematosiphon inodorus* was credited with the abandonment of one Prairie Falcon (*Falco mexicanus*) nest (three eggs), and with the death of seven Prairie Falcon (broods of three and four) and two Red-tailed Hawk (*Buteo jamaicensis*) nestlings (Platt 1975).

We know of no studies citing *Protocalliphora* or Cimicidae infestation as the cause of a significant reduction in overall numbers of any avian species; thus, it is likely that a coexistence has developed between parasite and host (Gold and Dahlsten 1983). However, we would not rule out the possibility that heavy hematophagous parasite infestations may be detrimental to populations of species with low numbers that are under extreme environmental stress.

The three nestlings banded on 2 June 2002 were monitored to fledging (15 June) and for 8 days postfledging. Eight days postfledging, the nestling from which we removed the *P. sialia* was found dead at the base of a saguaro cactus. The carcass was intact with no sign of depredation or scavengery. That same day, another fledgling was found dead. The carcass was found in a saguaro cavity, and plucked feathers were visible at the entrance. AGF (Arizona Game and Fish Department) researchers could not determine whether the nestling was depredated or if it had died and then was scavenged. A concentrated effort (~1 hr) by six researchers failed to locate the remaining fledgling. AGF researchers returned to the nest area on three occasions and could not locate the third fledgling (D. J. Abbate pers. comm.). Because pygmy-owl fledglings do not disperse from their natal area until ~56 days postfledging (Proudfoot and Johnson 2000; GAP pers. obs.), AGF researchers assumed the remaining fledgling was also dead. Although pygmy-owls commonly reuse nest cavities (Weidensaul 1989), this nest cavity was not active during the next season (2003; D. J. Abbate pers. comm.). Notably, Cliff Swallows avoid nesting in areas with previously high infestation levels of *O. vicarius* (Brown and Brown 1992).

There is no direct evidence that parasitic blood loss had an effect on the survival of these pygmy-owls. It is possible that drought conditions in the Tucson Basin during 2002 (http://www.wrh.noaa.gov/twc/climate/seazDM.php) were a contributing factor. However, after reviewing recent research on *Protocalliphora* and Cimicidae, we would not rule out parasitic blood loss as a factor contributing to the mortality of these fledglings. Using hand removal of nest material, we collected 119 *H. sonorensis* (~40/nestling). Average infestation of *O. vicarius* in Barn Swallow and Cliff Swallow nests was 19 and 32/nestling, respectively (Orr and McCallister 1985). Brown and Brown (1992) reported averages of 199 and 565 *O. vicarius*/nest site. Assuming we collected 100% of the ectoparasites from the nest cavity, the parasite load (~40/nestling) we report exceeded levels reported by Orr and McCallister (1985), but it was considerably less than the deleterious infestation levels reported by Brown and Brown (1986, 1992, 2001, 2003). Cimicidae, however, are considered nocturnal and are known to crawl into cracks and crevices during daylight (Usinger 1966). Thus, extracting nest material by hand during daylight most likely provided a conservative representation of *H. sonorensis* infestation. Hand removal of nest material also may have resulted in failure to extract mobile *P. sialia* larvae or puparia that were located in cavity crevices. In addition, as poikilothermic organisms, the growth rate of *Protocalliphora* is essentially a function of temperature (growth rate increases linearly with temperature; Adams and Hall 2003). Thus, with an average daily high temperature of >30° C during May and June in Tucson, Arizona (http://wc.pima.edu/Bfiero/tucsonecology/climate/stats.htm), we suspect that the life cycle of *P. sialia* in the Altar Valley of the Sonoran Desert is at or near the 18-day minimum for the species (Sabrosky et al. 1989). Because its life cycle in Arizona may be considerably shorter than the average time nestling pygmy-owls spend in the nest cavity (28 days; Proudfoot and Johnson 2000), it is possible that multiple *P. sialia* parasitized pygmy-owl nestlings, completed their life cycle, and left the cavity as adults before we extracted nest material. Regrettably, we did not search nest material for pupal cases.

The effect of hematophagous parasites on pygmy-owl productivity and nestling survival is not known and additional study is needed to assess the potential impact of these parasites on the endangered pygmy-owls of Arizona. The intent of this paper was to increase awareness of the parasitic association of *P. sialia* and *H. sonorensis* and pygmy-owls, and to raise the possibility of postfleding mortality attributable to these parasites.

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LITERATURE CITED

ADAMS, J. O. AND M. J. R. HALL. 2003. Methods used for the killing and preservation of blowfly larvae, and their effect on post-mortem larval length. Forensic Science International 138:50–61.

BOHM, R. T. 1978. *Protocalliphora* infestation in Great Horned Owls. Wilson Bulletin 90:297.

BOLAND, S. P., J. A. HALSTEAD, AND B. E. VALENTINE. 1989. Willow Flycatcher nestling parasitized by larval fly, *Protocalliphora cuprina*. Wilson Bulletin 101:127.

BROWN, C. R. AND M. B. BROWN. 1986. Ectoparasitism as a cost of coloniality in Cliff Swallows (*Hirundo pyrrhonota*). Ecology 67:1206–1218.

BROWN, C. R. AND M. B. BROWN. 1992. Ectoparasitism as a cause of natal dispersal in Cliff Swallows. Ecology 73:1718–1723.

BROWN, C. R. AND M. B. BROWN. 1999. Fitness components associated with laying date in the Cliff Swallow. Condor 101:230–245.

BROWN, C. R. AND M. B. BROWN. 2001. Egg hatchability increases with colony size in Cliff Swallows. Journal of Field Ornithology 72:113–123.

BROWN, C. R. AND M. B. BROWN. 2002. Ectoparasites cause increased bilateral asymmetry of naturally selected traits in a colonial bird. Journal of Evolutionary Biology 15:1067–1075.

BROWN, C. R. AND M. B. BROWN. 2003. Testis size increases with colony size in Cliff Swallows. Behavioral Ecology 14:569–575.

CHARMANTIER, A., L. E. B. KRUUK, AND M. LAMBRECHTS. 2004. Parasitism reduces the potential for evolution in a wild bird population. Evolution 58:203–206.

GOLD, C. S. AND D. L. DAHLSTEN. 1983. Effects of parasitic flies (*Protocalliphora* spp.) on nestlings of Mountain and Chestnut-Backed chickadees. Wilson Bulletin 95:560–572.

HILL, H. M. AND T. H. WORK. 1947. *Protocalliphora* larvae infesting nestling birds of prey. Condor 49: 74–75.

LOYE, J. AND T. W. REGAN. 1991. The cliff swallow bug *Oeciacus vicarius* (Hemiptera: Cimicidae) in Florida: ectoparasite implications for hole-nesting birds. Medical Veterinary Entomology 5:511–513.

MERINO, S. AND J. POTTI. 1998. Growth, nutrition and blow fly parasitism in nestling Pied Flycatchers. Canadian Journal of Zoology 76:936–941.

MULLEN, G. R. AND L. A. DURDEN. 2002. Medical and veterinary entomology. Academic Press, San Diego, California.

O'BRIEN, E. L., B. L. MORRISON, AND L. S. JOHNSON. 2001. Assessing the effect of hematophagous ectoparasites on the health of nestling birds: haematocrit vs. haemoglobin levels in House Wrens parasitized by blow fly larvae. Journal of Avian Biology 32:73–76.

ORR, T. AND G. MCCALLISTER. 1985. American swallow bug, *Oeciacus vicarius* Horvath (Hemitera: Cimicidae), in *Hirundo rustica* and *Petrochelidon pyrrhonota* nests in west central Colorado. Great Basin Naturalist 47:345–346.

PLATT, S. W. 1975. The Mexican chicken bug as a source of raptor mortality. Wilson Bulletin 87:557.

PROUDFOOT, G. A. AND R. R. JOHNSON. 2000. Ferruginous Pygmy-Owl (*Glaucidium brasilianum*). The Birds of North America, no. 498.

ROBY, D. D., K. L. BRINK, AND K. WITTMANN. 1992. Effects of bird blowfly parasitism on Eastern Bluebird and Tree Swallow nestlings. Wilson Bulletin 104:630–643.

SABROSKY, C. W., G. F. BENNETT, AND T. L. WHITWORTH. 1989. Bird blow flies (*Protocalliphora*) in North America (Diptera: Calliphoridae), with notes on the Palearctic species. Smithsonian Institution Press, Washington, D.C.

USINGER, R. L. 1966. Monograph of Cimicidae (Hemiptera-Heteroptera). Entomology Society of America, College Park, Maryland.

U.S. FISH AND WILDLIFE SERVICE. 1997. Endangered and threatened wildlife and plants; Determination of endangered status for the Cactus Ferruginous Pygmy-Owl in Arizona. Federal Register 62: 10730–10747.

U.S. FISH AND WILDLIFE SERVICE. 2003. Cactus Ferruginous Pygmy-Owl (*Glaucidium brasilianum cactorum*) draft Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

WEIDENSAUL, S. 1989. North American birds of prey. Gallery Books, New York.